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Outcome after VAC® Therapy for Infected Bypass Grafts in the Lower Limb

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WHAT THIS PAPER ADDS?

- Vacuum-assisted wound closure (VAC®) treatment of infected bypass graft for lower limb ischaemia is an alternative minimally invasive treatment to radical solutions such as resection or complete removal of bypasses followed by vascular reconstruction.

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ABSTRACT

Objective: To assess the outcome of vacuum-assisted wound closure (VAC®) therapy for infected bypass grafts.
Methods: A retrospective 7-year review of patient records from 2004 to 2011 of all patients receiving VAC® therapy for infected bypass grafts.
Results: Thirty-seven patients with 42 wounds and 45 infected bypass (28 synthetic) grafts received VAC® treatment. Two serious bleeding episodes from the suture lines occurred. The median VAC® therapy time was 20 days. The proportion of patent bypass grafts was 91% (41/45) at a median time of 3.5 months from the start of VAC® therapy. Five patients with seven bypasses had persistent infection or re-infection, and the total graft preservation rate was 76% (34/45). The median follow-up time was 15 months. The presence of two infected bypass grafts in one groin wound was associated with an increased major amputation rate (hazard ratio (HR) 7.4 [95% confidence interval (CI) 2.0–27.5]), and synthetic graft infection (HR 5.0 [95% CI 1.5–17.4]) and non-healed wound (HR 3.6 [95% CI 1.5–8.7]) were associated with mortality.
Conclusion: VAC® therapy of infected bypass grafts was able to induce effective wound healing without compromising the early bypass function. Two infected synthetic bypasses in the wound were associated with the highest risk of adverse outcome.

Deep peri-vascular postoperative wound infection in the groin after arterial surgery is related to severe morbidity, long and costly hospital stays, leg amputation and death.[1] Patients with infection of an exposed synthetic graft in the groin have often been treated by removal or excision of the graft, with or without revascularisation with an extra-anatomic bypass or in situ vein-bypass, with subsequent high risk of both leg amputation and death.[2] Exposed and infected grafts are sometimes treated with muscle flap coverage and antibiotics in an attempt to preserve the vascular reconstruction, but the re-infection rate has been reported to be as high as 66%.[3] Vacuum-assisted wound closure (VAC®) therapy of infected grafts in the groin alone has emerged as a simple and much less invasive alternative to radical surgical solutions.[4,5]

Negative pressure wound therapy (NPWT), of which VAC® therapy is one particular system of treatment, has been reported to have several beneficial effects on healing wounds such as creating a moist wound-healing environment, drainage of superfluous fluid, reduction of tissue oedema, cleansing deep wounds from bacteria, accelerating the formation of vascularised granulation tissue and faster approximation of wound edges.[4–6]

VAC® therapy for deep wound infections following vascular surgery has become routine in many hospitals worldwide. The extension and depth of infection and the existence of synthetic material in the wound are factors associated with morbidity, amputation and mortality.[4] Experience with VAC® therapy for infected bypasses in the lower limb, however, is limited.[7] There are

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two main concerns with this treatment modality for infected bypasses. First, the amount of graft material in the wound is so much larger compared to a patch or suture repair of an artery, and there is always a risk that the infection spreads along the bypass graft and the channel around the bypass. Second, the topical negative pressure exerted on the bypass may in fact induce kinking of the graft, resulting in a decreased flow within the bypass and an increased risk of bypass occlusion.

The aim of the present study was to assess early bypass graft patency, and risk factors associated with wound healing, major amputation and mortality after VAC® therapy for infected bypass grafts in the lower limb.

Material and Methods

Study population and setting

The Vascular Centre, Malmö-Lund, Malmö, Skåne University Hospital is a tertiary referral centre for the southernmost part of Sweden with a primary catchment population of approximately 800,000 inhabitants (Swedish Central Bureau of Statistics, www.scb.se).

Patients undergoing groin incisions for any vascular procedure were routinely given three prophylactic doses of the antibiotic dicloxacillin (Ekvacillin®), where the first dose was administered at induction of anaesthesia. Crosschecking for VAC®-treated patients was performed through our wound surveillance register that were established and validated in 2007. According to this register, the number of patients with peri-vascular groin infections (native artery, and vein and synthetic prosthetic infections) during the last 5 years of this study (February 2007–January 2012) was 66 or an incidence of 1.7 per 100,000 person years. The number of patients with peri-vascular infected bypass grafts was 24 during this period, corresponding to an incidence of 0.6 per 100,000 person years. A retrospective study of patient records from 1st of August 2004 until 31st of December 2011 of all patients receiving VAC® therapy for peri-vascular infected bypass grafts (Szilagyi grade III)[1] after vascular surgery was performed. Computed tomography (CT) angiography was usually performed to evaluate the extent of the bypass graft infection. Any duplex, CT angiography, ankle–brachial index or clinical examination to assess the bypass function was documented in the early follow-up, and local wound complications, persistent or re-infection of the bypass, amputation and mortality were checked from the day of wound debridement and revision to the end of follow-up, 8th of March 2012.

Treatment policy of VAC® therapy

Patients with deep wound infections underwent surgery for wound revision with either regional or general anaesthesia. Wound cultures adjacent to the bypass grafts were obtained. VAC® therapy was usually started the day after the revision at the surgical ward. After administration of morphine intravenously, a polyurethane sponge (KCI Medical, San Antonio, TX, USA) was applied with a continuous topical negative pressure of 125 mmHg (standard negative pressure in wound therapy recommended by KCI Medical) (Fig. 1). Changes of dressings were performed after pain relief with morphine intravenously at the surgical ward three times per week. Visible graft material and native arteries were covered routinely with a non-adhesive silicon-based dressing (Mepitel®, Mölnlycke Health Care AB, Göteborg, Sweden) to minimise any possible trauma to the vascular anastomosis, which hypothetically could be generated by the VAC® therapy. The patients were treated in-hospital, and usually with intravenous antibiotic therapy that matched with the bacterial resistance pattern from the wound cultures, as long as any graft material or native artery was visible. In the case of a negative initial wound culture, dicloxacillin or piperacillin–tazobaktam (after revised local guidelines) was usually given intravenously until a later wound culture indicated otherwise. As soon as the bypass graft was covered with granulation tissue, in an otherwise fit patient, VAC® therapy sometimes was carried out at home with the mini-VAC® portable device (VAC® Freedom), to achieve earlier hospital discharge and reduction in in-hospital costs. Two secondary wound closures in the groin were performed after 24 and 41 days of VAC® therapy. The wound was followed until full skin epithelialisation. Perioral antibiotic therapy was usually continued for another 1–6 months after complete wound healing.

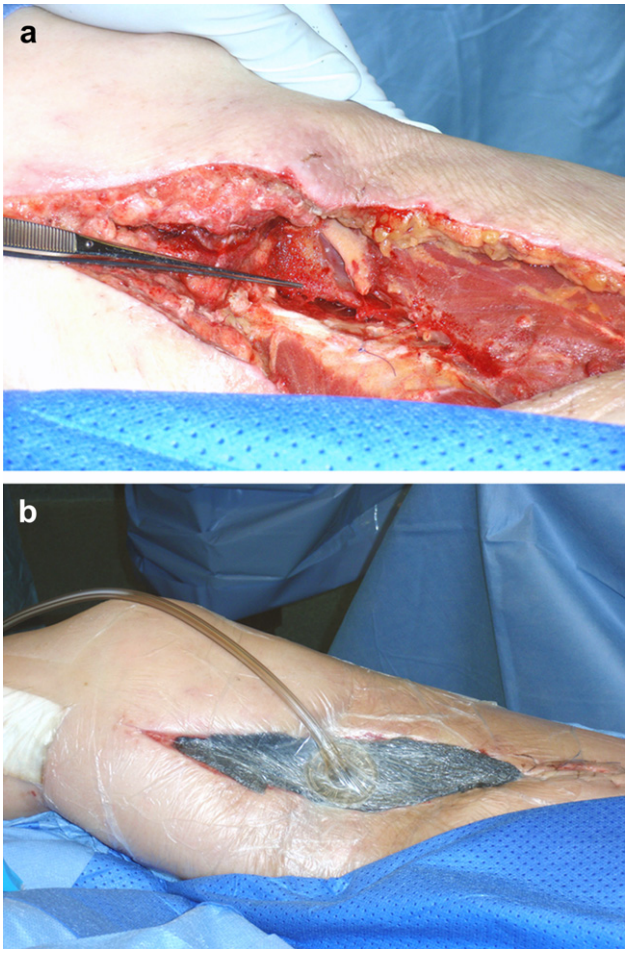

Figure 1. Patient who underwent radical extirpation for a sarcoma in the right thigh. The femoral vein and superficial femoral artery were resected. Arterial reconstruction with a reversed saphena magna bypass graft, harvested from the contralateral leg, was performed. The vascular anastomoses were located at the proximal superficial femoral artery and in the popliteal artery below knee. Postoperative wound necrosis and infection developed. a) The forceps points at the saphena magna graft running visible a few centimetres in the bottom of the wound. b) The VAC® therapy applied. The wound was completely healed after 76 days and duplex showed an unremarkable and patent bypass graft.

Definitions

Early infection occurred within 3 months and late after 3 months from the responsible bypass surgical procedure.[5] Hypertension was defined if the patient previously had been diagnosed with hypertension or was taking anti-hypertensive medication. Cerebrovascular disease was considered if there was a history of

stroke (cerebral bleeding or infarction) or transient ischaemic attack (TIA). Ischaemic heart disease was considered if there was a history of myocardial infarction, angina pectoris, coronary artery bypass graft or percutaneous coronary angioplasty. Diabetes mellitus was noted if the patient had antidiabetic treatment with diet, oral hypoglycaemic agents or insulin. Smoking included both current and former tobacco smokers. Anaemia was defined as haemoglobin <134 g l^{-1} in men and <117 g l^{-1} in women. Glomerular filtration rate (GFR) was calculated by entering serum creatinine level, age, gender and race into a formula provided by the Modification of Diet in Renal Disease Study Group.[8] Renal insufficiency was present if GFR was <60 ml min^{-1} in patients aged 50–65 years and <50 ml min^{-1} in patients >65 years. Major amputation was defined as any amputation above the level of tarsometatarsal joint. Complete wound healing was defined as full skin epithelialisation and freedom from signs of local clinical infection. The term EndoVAC refers to salvage of an arterial reconstruction by reinforcing the infected vascular segment, that is, sealing an extravasation from an arterial wall defect, pseudoaneurysm or fistula, first by an endovascular stent-graft prosthesis, followed by wound debridement and application of VAC® therapy.[9]

Statistical methods

Data management and statistical analysis were performed using the SPSS for Windows, version 18.0 (SPSS Inc., Chicago, IL, USA). Differences in proportions were analysed with the chi-square test or Fisher's exact test. Continuous variables were expressed in median and range. Patient survival was analysed according to the Kaplan–Meier method with life table. Associations between factors and mortality during follow-up were tested in a univariate Cox regression model, and significant associations were expressed in terms of hazard ratios (HRs) with 95% confidence interval (CI). *P*-values <0.10 are denoted in Table 2 and $p < 0.05$ were considered significant.

Results

Patient characteristics

The median age of the 37 patients was 74 years (range 48–88 years). Co-morbidity factors such as hypertension and smoking were both present in 37 (88%) out of the 42 VAC®-treated wounds. Detailed description of co-morbidities and wound characteristics are shown in Table 1 and Table 2, left column. The microbiology results from the initial wound cultures obtained at primary surgical revision are shown in Table 3. Positive wound cultures were obtained in 83% (35/42) of the wounds at surgical revision. Patients with two infected bypasses in the groin wound ($n = 9$) were infected in seven cases by *Pseudomonas aeruginosa* ($n = 3$), *Enterococcus faecalis* ($n = 1$), *Enterococcus faecium* ($n = 1$), *Proteus vulgaris* ($n = 1$), anaerobic bacteriae ($n = 1$), *Staphylococcus aureus*

Table 1
VAC® therapy, wound healing and bypass graft function.

Wound treatment characteristics	
Treated wounds/bypass grafts/patients	42/45/37
Abdominal wall/groin/thigh/calf	1/36/4/1
Synthetic grafts (%)	28 (67)
Duration of VAC® therapy	
Days; median (range)	20 (1–119)
Proportion of wounds treated outside hospital (%)	14 (33)
Results	
Proportion of healed wounds (%)	30/40 (75)
Time to full skin epithelialisation (days); median (range)	75 (36–289); $n = 28$
Patent bypass graft at first follow-up (%)	41/45 (91)

Table 2
Predictors for complete wound healing, amputation and mortality during follow-up after VAC® therapy of infected bypass grafts.

	Wounds (%)	Wound healed (%)	Major amputation (%)	Mortality (%)
VAC® therapy (all)	42	30/40 (75)	14 (33)	23 (55)
Women	11 (26)	8/10 (80)	3 (27)	6 (54)
Age $\geq$ 75 years	19 (45)	13/18 (72)	3 (16)	12 (63)
Co-morbidities				
Ischaemic heart disease	18 (43)	11/17 (65)	8 (44)	12 (67)
Diabetes mellitus	12 (29)	9 (75)	6 (50)	8 (67)
Lower limb ischaemia	24 (57)	16/23 (70)	9 (38)	11 (46)
Cerebrovascular disease	7 (17)	7 (100)	1 (14)	3 (75)
Previous vascular surgery	29 (69)	20/28 (71)	12 (41)	15 (52)
Laboratory tests just prior to surgical revision				
CRP ? 100 mg/L	17/28 (61)	11/16 (69)	9 (53)	12 (71)
Renal insufficiency	22 (52)	14/21 (67)	7 (32)	13 (59)
Anaemia	34 (81)	22/32 (69)	11 (32)	20 (59)
Surgical factors				
Multiple previous groin incisions	26 (62)	18/25 (72)	11 (42)	13 (50)
Re-operation for bleeding	15 (36)	10/14 (71)	6 (40)	9 (60)
Synthetic graft infection	28 (67)	19/26 (73)	12 (43)*	20 (71)**
Two bypasses	9 (21)	4/8 (50)	6 (66)***	6 (66)*
Wounds and microbiology				
Staphylococcus aureus at surgical revision	7 (17)	3 (43)	1 (14)	4 (57)
Intestinal flora at surgical revision	29 (69)	20/27 (74)	11 (38)	16 (55)
Critical limb ischaemia with foot ulcer	13 (31)	11 (85)	5 (38)	5 (38)
Outcome				
Wound not healed	10/40 (25)	–	5 (50)	8 (80)***
Major amputation	14 (33)	9 (64)	–	10 (71)

*$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.

Table 3
Microbiology. Results of the wound cultures obtained at primary surgical revision in the 42 wounds.

	N
Skin flora	
Staphylococcus aureus	7
Staphylococcus species	3
Streptococcus	1
Intestinal flora	
Enterococcus faecalis	9
Pseudomonas aeruginosa	7
Proteus mirabilis	7
Escherichia coli	4
Enterococcus faecium	4
Citrobacter freundii	2
Klebsiella pneumoniae	1
Proteus vulgaris	1
Corynebacterium species	1
Serratia marcescens	1
Anaerobic bacteriae	3
Faecal flora	1
Candida albicans	1
Sum	53

($n = 1$) and *Staphylococcus* species ($n = 1$), whereas two groin wounds were negative in bacterial growth. Primary indications for bypass surgery, which eventually led to deep wound infection, were critical lower limb ischaemia ($n = 18$; 43%), abdominal aortic aneurysm ($n = 12$; 29%), acute lower limb ischaemia ($n = 3$; 7%), claudication ($n = 3$; 7%), chronic femoral artery pseudo-aneurysm ($n = 2$; 5%), femoral artery aneurysm ($n = 1$; 2%), mycotic femoral artery aneurysm (sepsis by *S. aureus*) ($n = 1$; 2%) and reconstruction of arterial flow after extirpation of sarcoma in the thigh ($n = 1$; 2%). The main clinical presentation of the deep wound infections included the following: infected haematoma ($n = 15$; 36%), skin necrosis at surgical site ($n = 9$; 21%), local bleeding ($n = 7$; 17%), abscesses ($n = 6$; 14%), pseudo-aneurysm ($n = 2$; 5%), fistula to the skin ($n = 2$; 5%) and sepsis ($n = 1$; 2%). Thirty-five (83%) wound infections developed early and seven (17%) developed late.

The bypass operations

The bypass operations performed are shown in Table 4. Infected synthetic bypass grafts were present in two-thirds (67%) of all 42 wounds. All 28 synthetic bypasses were made of polytetraflouroethylene (PTFE, Gore-Tex®). Two reconstructions of the femoral artery were performed with an interposition graft of an excised and thrombendarterectomised superficial femoral artery. One interposition bypass graft in the femoral artery was an exposed stent graft sealing a large infected opening in the common femoral artery. Eight patients had two infected bypasses: aorto-bifemoral + femoro-femoral interposition bypass ($n = 3$), aorto-bifemoral + femoro-femoral bypass ($n = 1$), aorto-bifemoral + femoro-distal bypass ($n = 1$), aorto-bifemoral + iliaco-femoral (*obturatorius*) bypass ($n = 1$), femoro-femoral + femoro-popliteal bypass ($n = 1$) and femoro-femoral interposition + femoro-popliteal below knee bypass ($n = 1$).

VAC® therapy

VAC® therapy was administered to 42 different infected wounds and to 45 bypass grafts in 37 patients (Table 1). No information of wound healing was possible to obtain in two patients, but 30 (75%) wounds healed completely among the evaluable remaining 40 patients. The VAC® therapies were administered to groin wounds in 86% (36/42) and to non-groin wounds in 14% (Table 1). Bleeding episodes during VAC® therapy occurred in three patients, two bleedings were from the vascular anastomoses and one from the granulation tissue. The two patients with serious bleeding episodes had a femoral mycotic aneurysm presenting early due to *S. aureus* sepsis repaired with an arterial interposition graft between the common femoral artery to the profunda artery and a fistula in the groin presenting late after aorto-bifemoral and femoro-femoral interposition synthetic bypass procedures, respectively. The suture lines from their vascular anastomoses were resected without pursuing an alternative vascular reconstruction, and both died in hospital due to sepsis and leg ischaemia, respectively. Four *sartorius* muscle transposition flaps in four groins in three patients were performed as an additional wound treatment modality and five stent graft (three Fluency®, Bard Peripheral Vascular, Tempe, AZ, USA) and two VIABAHN (Gore, Flagstaff, AZ, USA) treatment of the common femoral artery via the endovascular route were performed as reinforcement of the common femoral artery due to formation of pseudo-aneurysm ($n = 3$) and arterio-cutaneous fistula ($n = 2$) as a part of an endoVAC procedure The median VAC® therapy time was 20 days (range 1–119) and the median in-hospital stay was 30 days (6–115).

Table 4
Graft anatomy and material among 37 patients with 45 bypasses undergoing VAC® therapy for infected bypass grafts in the lower limb.

By-pass graft anatomy	Patients (%)	Vein:Synthetic:Artery
Aorto-bifemoral bypass	3 (8)	0:3
Iliaco-femoral bypass	1 (3)	0:1
Femoro-femoral crossover bypass	7 (19)	1:6
Femoro-femoral interposition bypass	6 (16)	0:4:2
Femoro-popliteal above knee bypass	3 (8)	3:0
Femoro-popliteal below knee bypass	8 (22)	7:1
Femoro-distal bypass	1 (3)	1:0
Two bypass grafts	8 (22)	3:13
All	37	15:28:2

Bypass graft patency after VAC® therapy

The proportion of patent bypass grafts was 91% (41/45) at a median time of 3.5 months from the surgical wound revision and start of VAC® therapy. Four bypasses were occluded: the two patients referred to above with serious bleeding episodes had two and one bypass graft, respectively. One bypass graft, with poor outflow conditions for succeeding revascularisation, was found to be occluded postoperative. The bypasses were controlled after termination of VAC® treatment, and usually after the wound had healed completely, by duplex ($n = 17$; 41%), CT angiography ($n = 11$; 26%) and ankle-brachial index ($n = 14$; 33%).

Persistent infected or re-infected bypass grafts

After the VAC® therapy period until end of follow-up, five patients, with a total of seven bypasses, had serious persistent infected or re-infected bypass grafts: two patients with two infected bypass grafts each in the groin underwent several reoperations and finally graft resection without reconstruction, major amputations and death. Two patients had their infected femoro-femoral crossover bypass removed and replaced with a *saphena magna* vein bypass graft with uneventful courses. One patient had his femoro-femoral bypass graft removed. Reconstruction was not necessary since the patient already had undergone transtibial amputation on the affected leg. The total graft preservation rate after VAC® therapy of infected bypass grafts was 76% (34/45).

Factors associated with wound healing, amputation and mortality

The median follow-up time was 15 (range 0.2–70) months. The complete wound healing rate was 75%, the major amputation rate was 33% and the mortality rate was 55% at the end of follow-up (Table 2). Five major amputations were performed as a consequence of the groin infection and nine due to worsening of the patients' critical limb ischaemia. One minor amputation (toe amputation) was performed. The presence of two infected bypass grafts in one groin wound was associated with an increased major amputation rate ($p = 0.003$: HR 7.4 [95% CI 2.0–27.5]). There was a trend ($p = 0.064$) that synthetic graft infection was associated with an increased major amputation rate. The 30-day and in-hospital mortality rate were 5% (2/42) and 19% (8/42), respectively, and the long-term mortality are shown in Fig. 2. Synthetic graft infection ($p = 0.011$; HR 5.0 [95% CI 1.5–17.4]) and an unhealed wound ($p = 0.005$; HR 3.6 [1.5–8.7]) were factors associated with mortality, and there was a trend that the presence of two infected bypass grafts ($p = 0.068$; HR 2.4 [95% CI 0.9–6.3]) was associated with mortality in an uni-variate Cox regression analysis.

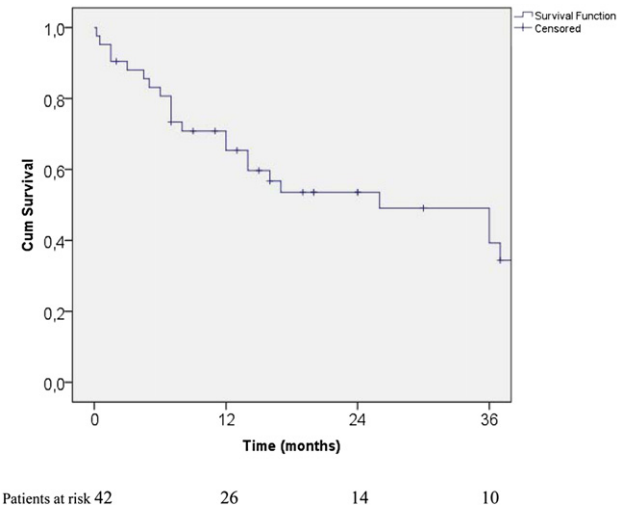

Figure 2. Long-term survival after VAC® therapy for infected by-pass grafts. Numbers below time axis denote patient wounds at risk at the respective time point. The tick marks indicate censored data.

Discussion

The collected data from the present study represent one of the largest experiences of infected bypass grafts treated with VAC® therapy. The high early bypass patency rate after VAC® therapy of deep peri-vascular wound infection suggests that VAC® therapy alone was capable of cleansing the wound, prevent infection along the bypass and promote wound healing without compromising the early bypass graft function in a decisive way during VAC® therapy. The bypass graft preservation rate was high, even at mid-term, and high-risk procedures for excess morbidity and mortality such as bypass removal and replacement were avoided. Indeed, two recent encouraging reports[5,10] have shown a low re-infection rate of grafts after VAC® therapy. On the other hand, one report has shown that, aggressive staged surgical debridement, antiseptic and antibiotic bed placement for 'wound sterilisation', *sartorius* muscle flap, graft excision or removal followed by in-situ vascular conduit replacement with either rifampicin-PTFE or autologous vein bypass, can achieve a high amputation-free survival rate in a dedicated vascular centre.[11]

However, the present study has identified high-risk patients for failure of graft preservation, major amputation and mortality, such as those with two synthetic bypasses, converging in the infected groin. First, the large amount of synthetic graft material with two grafts creating a rugged area at the bottom of the wound makes the wounds and the grafts difficult to cleanse free from bacteria. Second, failure of preserving one graft will affect the other, with a high likelihood of a major amputation. Third, large suture lines forming the vascular anastomosis are present with the inherent increased risk of suture line breakage, disruption of the anastomosis and bleeding during VAC® therapy. Fourth, the presence of two synthetic bypasses in one patient may be seen as a marker for advanced atherosclerotic disease with an increased risk of mortality during follow-up. Even if the risk of severe bleeding complication from the suture line among all study patients was low, it justifies close surveillance of the bypass graft within hospital as long as the graft is not incorporated with granulation tissue. If synthetic bypass grafts are preserved and the wounds eventually heal, these grafts should be considered to be bacterially contaminated for a long time onwards and long-term antibiotic therapy should be mandatory in most cases to attempt to avoid the risk of clinical re-infection. Close follow-up includes clinical examination, laboratory tests and CT angiography imaging of the affected area. The study results suggest that patients with persistent infection or re-infection of a femoro-femoral crossover synthetic bypass may be better treated with removal of the graft and replacement with a *saphena magna* vein crossover bypass graft.

Sartorius muscle flap transpositions in the groin were occasionally performed in the present study as an adjunctive procedure after wound debridement and VAC® therapy to accelerate wound healing. Since prophylactic muscle flap transposition procedures have been recommended in high-risk patients with synthetic graft material in the groin,[12,13] it may be worthwhile to consider such procedure in some high-risk patients with two synthetic bypass grafts converging in the groin. Stent-graft placement in the common femoral artery followed by wound debridement, endo-VAC,[8] were performed in rare occasions at the present highly endovascular oriented unit. The rationale for this endovascular approach, however, should be considered as experimental in view of those other open surgical options that were available and may only be used as a definitive bale-out procedure.

The majority of the wounds were infected with bacteria pertaining to the intestinal flora. *S. aureus* infection at the time point of the initial surgical debridement operation was not found to be associated with an unhealed wound, which may be attributed to a statistical type II error. In a recent report, *S. aureus* infection was associated with mortality,[5] which partly may be attributed to its more aggressive virulence properties[14] compared to bacteria pertaining to the intestinal flora. In addition, patients presenting with late infections after the index operation have been found to be at a higher risk for subsequent re-infection after VAC® therapy.[5] Even if these patients with clinical re-infection could be re-treated with debridement and VAC® therapy to achieve cure,[5] this finding implicates that proper treatment with surgical debridement and VAC® therapy should be initiated emergently as soon as diagnosis is clear to stop further spreading of the infection along the bypass graft, and minimise the risk of re-infection.

The overall major amputation rate may be considered high. However, a large proportion of the patients had undergone previous vascular surgery and suffered from critical limb ischaemia, and most of the patients underwent major amputation due to critical limb ischaemia, not as a consequence of the infected bypass. The fact that the majority of the study patients had synthetic infected bypass grafts has important clinical implications on outcome, since placement of any synthetic graft material is a risk factor for future surgical site infection or re-infection in the first place. When the synthetic graft infection is established, it is much more challenging to treat than infected vein bypass grafts. The mid- and long-term patency rates of infra-inguinal synthetic bypass grafts are inferior to vein bypasses, contributing to a subsequent higher amputation rate among those with synthetic bypass grafts.[15] The rather high overall mortality rate might be explained by the relatively high major amputation rate[4] and the high burden of illness among the study patients. For instance, the crude 1-year mortality rate in patients with critical limb ischaemia without a concomitant bypass graft infection has been reported to be 24% in the same city[16] as the present study population.

The limitations of the present study are attributed to its retrospective design and to incomplete duplex data on follow-up. The influence of body mass index on outcome data was not addressed. A multi-centre prospective study comparing outcome after VAC® therapy versus radical surgical solutions may be considered. However, such a study might be very difficult to conduct due to expected recruiting problems and for ethical reasons, since bypass excision/removal and extra-anatomic bypass/in-situ replacement is considered as a major surgical procedure, whereas wound debridement and VAC® therapy is considered a minimally invasive

procedure. Establishing a register containing information on perivascular wound infections would be helpful to find out more about the place of VAC® therapy.

In conclusion, VAC® therapy of infected bypass grafts seems to be able to induce effective wound healing without compromising the early bypass function. Two infected synthetic bypasses in the wound were associated with the highest risk of adverse outcome.

Conflict of Interest/Funding

None.

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